



**PATENT**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Application No.: 10/730,398  
Filing Date: 12/8/2003  
Applicants: Bieler et al.  
Group Art Unit: 1742  
Examiner: Sikyin Ip  
Title: METHODS FOR PRODUCING LEAD-FREE IN-SITU  
COMPOSITE SOLDER ALLOYS  
Attorney Docket: 6550-000013/COA

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Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**INFORMATION DISCLOSURE STATEMENT**

Sir:

Pursuant to 37 C.F.R. §§ 1.56, 1.97 and 1.98, Applicants hereby submit an Information Disclosure Statement for consideration by the Examiner.

**I. LIST OF PATENTS, PUBLICATIONS, AND OTHER INFORMATION**

The patents, publications and other information requested to be considered by the Office (except unpublished U.S. patent applications) are listed on Form 1449 attached hereto.

**II. COPIES**

A. X Submitted herewith is a legible copy of (i) each U.S. patent application publication and U.S. and foreign patent; (ii) each publication or that portion which caused it to be listed; (iii) for each cross-referenced pending U.S. application listed below in Section IV, the application specification including the claims, and any drawing of the application which caused it to be listed including the claims directed to that portion; and (iv) all other information or that portion which caused it to be listed.

B. X Any patents, publications or other information which are listed on Form 1449 or on the copies of PTO-892, but which are not enclosed herewith, were previously cited by or submitted to the PTO in one of the following applications which has been relied upon for an earlier filing date under 35 U.S.C. § 120:

U.S. Serial Number  
09/114,665

U.S. Filing Date  
July 13, 1998

C. X Because the present application was/is being filed after June 30, 2003, no copies of the U.S. patents or U.S. patent application publications which are listed on the attached Form 1449 are enclosed pursuant to the waiver of 37 C.F.R. § 1.98(a)(2)(i). Any foreign patent documents or non-patent literature listed on the attached Form 1449 are enclosed herewith.

D. \_\_\_\_ This is a PCT application in the entry of the National Phase in the United States. A copy of the International Search Report is attached for the Examiner's information. The documents listed on the International Search Report are listed on the attached Form-1449 for consideration by the Examiner and for listing on any patent resulting from this application. If the International Search Report was from the US, EPO, or JPO search authorities, copies of these references should have been supplied to the USPTO under the trilateral agreement and are believed to be in the file of the above-identified application. (MPEP 1893.03(g))

III. CONCISE EXPLANATION OF THE RELEVANCE (check at least one box)

A. X Except as may be indicated below in (B), all of the patents, publications or other information are in the English language (concise explanation not required).

B. \_\_\_\_ A concise explanation of the relevance of each patent, publication or other information listed that is not in the English language is as follows (see 37 C.F.R. § 1.98(a)(3)):

1. \_\_\_\_ See the attached foreign patent office communication from a counterpart foreign application.
2. \_\_\_\_ English translations are provided.
3. \_\_\_\_ Other:

C. X The following additional information is provided for the Examiner's consideration.  
See attached STATEMENT ACCOMPANYING INFORMATION DISCLOSURE STATEMENT

IV. CROSS REFERENCE TO RELATED APPLICATION(S)

A. \_\_\_\_ The Examiner is advised that the following co-pending application(s) contain(s) subject matter that may be related to the present application. By bringing this(these) application(s) to the Examiner's attention, Applicant(s) does(do) not waive the confidentiality provisions of 35 U.S.C. § 122.

Serial No.

Filing Date

Art Unit

V. THIS IDS IS BEING FILED UNDER

A. X 37 C.F.R. § 1.97(b): (check only one box)

1. \_\_\_\_ within three months of the filing date of a national application other than a continued prosecution application under § 1.53(d) (37 C.F.R. § 1.97(b)(1)). No fee or certification is required.
2. \_\_\_\_ within three months of the date of entry of the national stage as set forth in §1.491 in an international application (37 C.F.R. § 1.97(b)(2)). No fee or certification is required.
3. X before the mailing of a first Office Action on the merits (37 C.F.R. § 1.97(b)(3)). No fee or certification is required. In the event that a first Office Action on the merits has been issued, please consider this IDS under 37 C.F.R. § 1.97(c) and see the certification under 37 C.F.R. § 1.97(e) below; or, if no certification has been made, charge our deposit account a fee in the amount of \$180.00 as required by 37 C.F.R. § 1.17(p).
4. \_\_\_\_ before the mailing of a first Office Action after the filing of a request for continued examination under 37 C.F.R. § 1.114. No fee or certification is required.

B. \_\_\_\_ 37 C.F.R. § 1.97(c): (check only one box)

before the mailing date of either any Final Office Action under 37 C.F.R. § 1.113, a Notice of Allowance under 37 C.F.R. § 1.311, or an action that otherwise closes prosecution.

1. \_\_\_\_ No certification; therefore, a fee in the amount of \$180.00 is required by 37 C.F.R. § 1.17(p).
2. \_\_\_\_ See the certification below. No fee is required.

C. \_\_\_\_ 37 C.F.R. § 1.97(d):

after the mailing date of either a Final Office Action under 37 C.F.R. § 1.113 or a Notice of Allowance under 37 C.F.R. § 1.311, yet on or before payment of the issue fee.

1. \_\_\_\_ See the certification below. A fee in the amount of \$180.00 is required by 37 C.F.R. § 1.17(p).

VI. CERTIFICATION UNDER 37 C.F.R. § 1.97(e): (check only one box)

The undersigned hereby certifies that:

A. \_\_\_\_ each item of information contained in this IDS was first cited in a communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this IDS (See 37 C.F.R. § 1.97(e)(1)). See further statement under 37 C.F.R. 1.704(d) below in section VII, if applicable; or

B. \_\_\_\_ no item of information contained in this IDS was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the undersigned after making reasonable inquiry, no item of information contained in this IDS was known to any individual designated in 37 C.F.R. § 1.56(c) more than three months prior to the filing of this IDS (See 37 C.F.R. § 1.97(e)(2)).

C. \_\_\_\_ Some of the items of information were first cited in a communication from a foreign patent office. As to this information, the undersigned hereby certifies that each item of information contained in this IDS was cited in a communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this IDS. As to the remaining information, the undersigned hereby certifies that no item of this remaining information contained in this IDS was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the undersigned after making reasonable inquiry, no item of information contained in this IDS was known to any individual designated in 37 C.F.R. § 1.56(c) more than three months prior to the filing of this IDS.

VII. STATEMENT UNDER 37 CFR 1.704(d)

The undersigned hereby states that:

\_\_\_\_ each item of information contained in this IDS was cited in a communication from a foreign patent office in a counterpart application and this communication was not received by any individual designated in 37 C.F.R. § 1.56(c) more than thirty days prior to the filing of this IDS.

VIII. PAYMENT OF FEES (check only one box)

A. \_\_\_\_ A check in the amount of \$180.00 is enclosed for the above-identified fee.

B. \_\_\_\_ Please charge Deposit Account No. 08-0750 in the amount of \$180.00 for the above-indicated fee. A duplicate copy of this paper is attached.

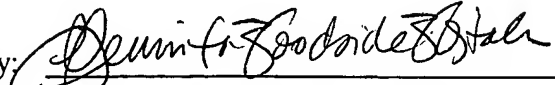
The above references are being cited only in the interest of candor and without any admission that they constitute statutory prior art, contain matter which anticipates the invention, or which would render the same obvious, either singly or in combination, to a person of ordinary skill in the art. Furthermore, this Information Disclosure Statement shall not be construed as a representation that a search has been made.

If it is determined that this IDS has been filed under the wrong rule, the PTO is requested to consider this IDS under the proper rule (with a petition if necessary) and charge the appropriate fee to Deposit Account No. 08-0750.

Please charge any additional fees or credit any overpayment pursuant to 37 C.F.R. § 1.16 or § 1.17 to Deposit Account No. 08-0750.

Respectfully submitted,

Dated: June 9, 2006

By:   
David L. Suter, Reg. No. 30,692  
Jennifer Woodside Wojtala, Reg. No. 50,721

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**STATEMENT ACCOMPANYING  
INFORMATION DISCLOSURE STATEMENT**

In the accompanying Information Disclosure Statement, Applicants wish to bring specific portions of two English language non-patent references to the Examiner's attention. In providing this statement, Applicants do not represent that the selected portions are the only relevant sections of the cited references.

1) Miller, et al., "A Viable Tin-Lead Solder Substitute: Sn-Ag-Cu", Journal of Electronic Materials, vol. 23, no. 7, pp. 595-601 (1994).

This article appears to be authored by some of the inventors of U.S. Patent No. 5,527,628 to Anderson et al. It describes a lead-free solder that has a eutectic point of ~217°C for a composition of Sn-4.7Ag-1.7Cu (wt.%), similar to the composition described in 5,527,628. See for example, Abstract, p. 598 Col. 1 to p. 599 Col. 1.

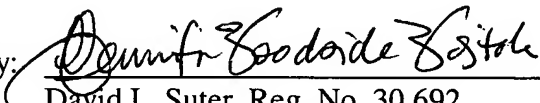
2) Moon, et al., "Experimental and Thermodynamic Assessment of Sn-Ag-Cu Solder Alloys", Journal of Electronic Materials, vol. 29, no.10, pp. 1122-1136 (2000).

This reference describes the 1994 Miller article (identified as No. 1 above) that described a ternary eutectic at  $\sim 217^{\circ}\text{C}$  having a composition of Sn - 4.7Ag - 1.7 Cu (wt. %). The Moon reference states that this article became the subject of U.S. Patent No. 5,527,628. The Moon reference further describes that "[p]reliminary thermodynamic calculations performed by one of the authors [ ] and reported by Miller et al. predicted a ternary eutectic...an error was made in the conversion from atomic to weight % conversion by Miller et al. The composition obtained from the initial estimate was Sn - 3.25 wt.% Ag- 0.69 wt.% Cu." (Footnotes omitted). See Moon at p. 1122 Col. 2 bridging p. 1123 Col. 1.

If the Examiner should have any questions or believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

Dated: June 9, 2006

By:   
David L. Suter, Reg. No. 30,692  
Jennifer Woodside Wojtala, Reg. No. 50,721

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<b>FORM HDP-1449 (Based on Form PTO-1449)</b>  <b>PATENT AND TRADEMARK OFFICE</b> <b>INFORMATION DISCLOSURE CITATION</b> (Use several sheets if necessary)  Sheet 1 of 3	ATTORNEY DOCKET NO.	SERIAL NO.
	6550-000013/COA	10/730,398
	APPLICANT	
	Biehler, et al.	
	FILING DATE	GROUP
	12/8/2003	1742

U.S. PATENT DOCUMENTS						
Ref. Desig.	Examiner's Initials	Document Number	Date	Name	Class/ Subclass	(If appropriate) Filing Date
1.		3,481,795*	12/1969	Lane		
2.		4,248,905*	12/1981	Harvey		
3.		4,358,884*	11/1982	Harvey et al.		
4.		4,506,822*	3/1985	Hammersand et al.		
5.		5,066,544*	11/1991	Betrabet et al.		
6.		5,094,700*	3/1992	Sekhar		
7.		5,344,607*	9/1994	Gonya et al.		
8.		5,429,689*	7/1995	Shangguan et al.		
9.		5,527,628*	6/1996	Anderson et al.		

\* Previously submitted in an IDS in parent application.

OTHER DOCUMENTS (including Author, Title, Date, Pertinent Pages, etc.)		
Ref. Desig.	Examiner's Initials	
1.		Anderson, et al., "Microstructural Modifications and Properties of Sn-Ag-Cu Solder Joints Induced By Alloying", Journal of Electronic Materials, vol. 31, no. 11, pp. 1166-1174 (2002)
2.		Attarwala, A.I. et al., "Confirmation of Creep and Fatigue Damage in Pb/Sn Solder Joints," J. Electron. Packag. 114:109-111 (1992)*
3.		Betrabet, H.S. et al., "Processing Dispersion-Strengthened Sn-Pb Solders To Achieve Microstructural Refinement And Stability," Script Metall. 25:2323-2328 (1991)*
4.		Betrabet, H.S. et al., "Towards Increased Fatigue Resistance In Sn-Pb Solders By Dispersion Strengthening," Proc. Conf. NEPCON., West Anaheim, CA, pp. 1276-1277 (1992)*
5.		Clough, R.B. et al., "Preparation And Properties Of Reflowed Paste And Bulk Composite Solder," Proc. Conf. NEPCON., West Anaheim, CA, pp. 1256-1265 (1992)*
6.		Frear, D.R. et al., "Thermal Fatigue In Solder Joints," JOM, pgs. 18-22 (June, 1988)*

Examiner:	Date Considered:
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EXAMINER: Please initial if citation considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.



<p>FORM HDP-1449 (Based on Form PTO-1449)</p> <p><b>PATENT AND TRADEMARK OFFICE</b></p> <p><b>INFORMATION DISCLOSURE CITATION</b></p> <p>(Use several sheets if necessary)</p> <p>Sheet 2 of 3</p>	ATTORNEY DOCKET NO.	SERIAL NO.
	6550-000013/COA	10/730,398
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OTHER DOCUMENTS (including Author, Title, Date, Pertinent Pages, etc.)		
Ref. Desig.	Examiner's Initials	
7.		Gibson, A.W. et al., "Issues Regarding Microstructural Coarsening Due To Aging Of Eutectic Tin-Silver Solder," Des. Reliab. Solders Solder Interconnect., Proc. Symp. (1997), 97-103*
8.		Ho, C.T. et al., "Carbon fiber reinforced tin-lead alloy as a low thermal expansion solder preform," <i>J. Mater. Res.</i> 5(6):1266-1270 (1990)*
9.		Jin, S., "Solder Materials Issues In High-Density Interconnection And Packaging," <i>Final Program ASM-TMS Materials Week '96</i> , ASM International and The Minerals, Metals & Materials Society, Cincinnati, Ohio, pp. 116 (1996)*
10.		Kuo, C.G. et al., "Fatigue Deformation Of In-Situ Composite Solders," 1st Int'l. Conf. Microstructures and Mechanical Properties of Aging Materials, ed. P.K. Liaw, R. Viswanathm, K.L. Murty, E.P. Simonen and D.R. Frear, The Minerals Metals & Materials Society, TMS, Warrendale, PA, pp. 417-423 (1993)*
11.		Kuo, C.G. et al., "Tensile And Creep Properties Of In-Situ Composite Solders," 1st Int'l. Conf. Microstructures and Mechanical Properties of Aging Materials, ed. P.K. Liaw, R. Viswanathm, K.L. Murty, E.P. Simonen and D.R. Frear, The Minerals Metals & Materials Society, TMS, Warrendale, PA, pp. 409-415 (1993)*
12.		Lau, J.H. et al., "Solder Joint Fatigue In Surface Mount Technology: State of the Art," <i>Solid State Tech.</i> pp. 91-104 (1985)*
13.		Lewis, R. (Ed.), <i>Hawley's Condensed Chemical Dictionary</i> , Thirteenth Ed., p. 483*
14.		Marshall, J.L. et al., "Composite Solders," <i>IEEE Trans. Comp. Hybrids Manuf. Tech.</i> 14(4):698-702 (1991)*
15.		Marshall, J.L. et al., "Microcharacterization Of Composite Solders," <i>Proc. Conf. NEPCON.</i> , West Anaheim, CA, pp. 1278-1283 (1992)*
16.		McCormack, M. et al., "Enhanced Solder Alloy Performance by Magnetic Dispersions," <i>IEEE Trans. Comp. Hybrids Manuf. Tech.-Part A</i> 17(3):452-457 (1994)*
17.		McCormack, M. et al., "The Design and Properties of New, Pb-Free Solder Alloys," <i>Proc. IEEE/CPMT Int'l Electronics Manufacturing Technology Symp.</i> pp. 7-14 (1994)*
18.		Miller, et al., "A Viable Tin-Lead Solder Substitute: Sn-Ag-Cu", <i>Journal of Electronic Materials</i> , vol. 23, no. 7, pp. 595-601 (1994).
19.		Moon, et al., "Experimental and Thermodynamic Assessment of Sn-Ag-Cu Solder Alloys", <i>Journal of Electronic Materials</i> , vol. 29, no.10, pp. 1122-1136 (2000)

Examiner: _____	Date Considered: _____
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<b>FORM HDP-1449 (Based on Form PTO-1449)</b>  <b>PATENT AND TRADEMARK OFFICE</b> <b>INFORMATION DISCLOSURE CITATION</b> (Use several sheets if necessary)  Sheet 3 of 3	ATTORNEY DOCKET NO.	SERIAL NO.
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OTHER DOCUMENTS (including Author, Title, Date, Pertinent Pages, etc.)		
Ref. Desig.	Examiner's Initials	
20.		Pinizzotto, R.F. et al., "Microstructural Development In Composite Solders Caused By Long Time, High Temperature Annealing," Proc. Conf. NEPCON., West Anaheim, CA, pp. 1284-1298 (1992)*
21.		Sastry, S.M.L., et al., "Microstructures And Mechanical Properties Of In-Situ Composite Solders," Proc. Conf. NEPCON, West Anaheim, CA, pp. 1266-1275 (1992)*
22.		Shangguan, D. et al., "Evaluation of Lead-Free Eutectic Sn-Ag Solder For Automotive Electronics Packaging Applications," Proc. IEEE/CPMT Int'l Electronics Manufacturing Technology Symp., pp. 25-37 (1994)*
23.		Shine, M.C. et al., "Fatigue of Solder Joints in Surface Mount Devices," ASTM STP 942:588-610 (1988)*
24.		Smithells Metals Reference Book, 7th ed., Butterworth Heinemann, Oxford, 1992, p. 11-242, "Adapted Sn-Ag-Cu Phase Diagram"*
25.		Tien, J.K. et al., "Creep-Fatigue Interactions in Solders," IEEE Trans. Comp. Hybrids Manuf. Tech. 12(4):502-505 (1989)*
26.		Wasynczuk, J.A. et al., "Shear Creep Of Cu <sub>6</sub> Sn <sub>5</sub> /Sn-Pb Eutectic Composites," Proc. Conf. NEPCON., West Anaheim, CA, pp. 1245-1255 (1992)*
27.		Weinbel, R.C. et al., "Creep-fatigue interaction in eutectic lead-tin solder alloy," J. Mater. Sci. 22:3901-3906 (1987)*

Examiner:	Date Considered:
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